Investigation by the Department of Telecommunications and Energy on its Own Motion into the Service Quality of Boston Edison Company Commonwealth Electric Company and Cambridge Electric Light Company, d/b/a NSTAR Electric

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I. <u>INTRODUCTION</u>

On August 24, 2001, the Department opened an investigation into the service quality of Boston Edison Company, Commonwealth Electric Company and Cambridge Electric Light Company, d/b/a NSTAR Electric (collectively "NSTAR" or "Company") ("Notice Opening Inquiry"). The Department stated that the focus of this investigation would be NSTAR's management of its distribution system. The Department specifically directed NSTAR to provide information in the following areas: growth forecasting; communication and notification procedures during outages; use of emergency generators and other equipment; personnel staffing and deployment during outages; weather forecasting; and, maintenance and design of its distribution system. The Department docketed this proceeding as D.T.E. 01-65.

On October 29, 2001, NSTAR filed a Report on System Reliability ("Report"). The Department held public hearings between November 26, 2001 and November 29, 2001, in Brookline, Stoneham, Boston, New Bedford, Medfield, Hyannis, and Arlington, Massachusetts. The Department also held a public hearing at our offices on January 17,

By letter dated September 12, 2001, the Department requested the following additional information regarding personnel: (1) adequacy of staffing levels for operation and maintenance of the distribution system, including inspection staffing levels; (2) identification and description of all training programs for employees engaged in electric service operation and restoration efforts; and (3) a cost/benefit assessment of establishing a program of periodic (i.e., over a specified cycle of years) inspection of both above-ground and underground distribution plant to be conducted by personnel who are expressly dedicated to inspection.

2002.² At these hearings, the Department took comments on the Report from elected public officials, representatives of the Commonwealth agencies, and members of the public.³

On January 30, 2002, the Office of the Attorney General ("Attorney General") and the Division of Energy Resources submitted joint comments ("Joint Comments"). On February 1, 2002, The Energy Consortium filed a letter endorsing the Joint Comments. NSTAR replied to the Joint Comments on February 15, 2002 ("Reply").⁴

II. NSTAR REPORT

A. <u>Introduction</u>

NSTAR's Report includes a review of the areas of inquiry raised by the Department as well as a description of the measures that NSTAR is implementing, or has planned, to

At this public hearing, the Department issued six record requests to which NSTAR responded.

The communities in which the public hearings were held are listed chronologically according to the date of each hearing and shall be identified in that order (<u>i.e.</u>, Tr. 7 shall refer to the public hearing in Arlington on November 29, 2001 and Tr. 8 shall refer to the public hearing at the Department's offices on January 17, 2002). In total, over 16 elected public officials, including the Attorney General, and 22 members of the public spoke at the public hearings.

The Joint Comments were filed in <u>BECo-ComElec Acquisition</u>, D.T.E. 99-19 (1999) and the Department's investigation of service quality <u>Investigation by the Department of Telecommunications and Energy on its Own Motion into the Service Quality of Boston Edison Company Commonwealth Electric Company and Cambridge Electric Light <u>Company</u>, <u>d/b/a NSTAR Electric</u>, D.T.E. 01-71A, as well as D.T.E. 01-65. The Joint Comments and Reply concern the amount of penalty that the Department should levy because of the distribution system outages during the Summer of 2001. This subject matter is addressed in D.T.E. 01-71A and not in this proceeding. The Joint Comments also include a request for an independent management audit of NSTAR. This request is discussed in Section II.G of this Order.</u>

improve system reliability. The Report includes assessments by three independent consultants of NSTAR's distribution system,⁵ as well as the results of NSTAR's own internal assessment. In this Order, we assess NSTAR's performance in the areas of which the Department inquired. In making this assessment, the Department appropriately exercises its supervisory authority pursuant to G.L. c. 164, § 76 without managing the daily activities of the Company. Cf. New England Telephone and Telegraph Co. v. Department of Public Utilities, 360 Mass. 443, 466-468, 483-484, 489 (1971) (interference with exercise of judgment by company business management is beyond Department's regulatory power and authority). Then, we address the Attorney General's and DOER's request for an independent management audit of NSTAR. Finally, the Order summarizes the recommendations and reporting requirements made throughout this Order.

B. Growth Forecasting

1. NSTAR

In its Notice Opening Investigation, the Department requested information regarding the adequacy of NSTAR's growth or load forecasting at the community, business district, or neighborhood level. The Department also solicited comments regarding improvements that could be made to NSTAR's load forecasting process. In response, NSTAR states that it has

NSTAR retained ABB Consulting to perform an overall assessment of NSTAR's distribution system and its restoration practices (Report 1, at 6). NSTAR retained KEMA Consulting and GeoIT to evaluate and suggest improvements to NSTAR's outage-management process and procedures (id.). NSTAR also contracted with Stone & Webster to perform in-depth engineering analysis of the root causes of three outages within the City of Boston (id.).

used a projected system-wide growth rate in formulating load forecasts in the past. The Company applied this rate in a uniform manner across the transmission and distribution ("T&D") system (Report 1, at 8). NSTAR admits that, in 2001, there were areas that experienced growth rates that were beyond the levels anticipated by the Company's system-wide planning approach (<u>id.</u> at 9).

NSTAR asserts that it has taken a number of steps to improve its long-range load forecasting process (Tr. 8, at 21). NSTAR states that, in 2001, it began to use a small-area, spatial-load forecast to determine growth rates on a narrower or more focused geographic basis (Report 1, at 8). NSTAR states that this process relies on land-use data on an area-by-area basis and considers load growth spurred by specific, significant development projects (id.). NSTAR argues that this will result in a more accurate load forecast for each individual substation and the distribution feeder associated with each substation (id.).

NSTAR also claims that it is making improvements to its planning process that uses the load forecasting discussed above (id. at 8). These improvements include the analysis of peak demand sensitivity to weather extremes and development of specific load-response characteristics experienced by equipment during those extremes (id.). NSTAR also states that it is in the process of implementing distribution load-flow analysis software, which will assist engineers in performing: (1) primary distribution system planning, operation and optimization studies; (2) per-phase voltage drop calculations; (3) fault calculations; (4) load balancing and load allocation studies; and (5) line switching, load transfer, and conductor upgrade studies (id. at 8-9).

2. <u>Analysis and Findings</u>

The Department has long-reviewed utility load forecasts. In the past, we have reviewed load forecasts with a view toward generating adequacy. See 220 C.M.R. §§ 10.00 et seq. In review of the Report, however, the Department's analysis focuses on the Company's use of load forecasts in the operation of the distribution system. <u>See Order</u> Commencing a Notice of Inquiry into (1) rescinding 220 C.M.R. §§ 10.00 et seq. and (2) exempting electric companies from any or all of the provisions of G.L. c. 164, § 69I, D.T.E. 98-84/EFSB 98-5 (1998). Load forecasting is a very important component of T&D facilities' expansion or upgrade planning. Accurate load forecasts allow planning engineers to simulate the behavior of transmission lines, distribution lines, and the equipment in between them. Accurate load forecasts, together with the correctly-modeled, planning databases in the distribution analysis software, allow engineers and management to envision future problems likely to happen through distribution system simulation during normal operating conditions and also during emergency conditions. Results of these simulations allow management to allocate necessary resources properly. Under-forecasts could stress the system beyond its capability and jeopardize the ability to serve customer load, and would make the distribution system more susceptible to frequent breakdown at various locations. Over-forecasts could unnecessarily result in excessive capital and human resources need estimates, ultimately leading to an over-built system needlessly costly to ratepayers.

As NSTAR's experience has shown, the use of a system-wide growth rate in formulating load forecasts does not allow disaggregation of load growth based on geography

and economics, including land use. It also does not take into account the new industrial or commercial load (step load) expected in certain areas in future years. For example, load growth in the City of Boston could be much different or higher than in other cities or in a rural area. Applying a system-wide growth rate in formulating load forecasts and applying it uniformly across the system would skew the transmission and distribution planning process and recommendations for the necessary upgrades, which in turn would send wrong signals of the system's capability to serve customer load.

The steps that NSTAR has taken, including adopting the use of small-area spatial load forecast to determine growth rates on a geographic basis, may improve its long-range forecasting and distribution facilities planning. Nonetheless, NSTAR has overlooked certain actions that will enhance its forecasting ability, which we discuss below.

First, NSTAR has included neither the probability levels nor some other statistically reliable means by which the normal and the extreme weather forecasts will be calculated. Extreme weather conditions could occur differently in other areas of the distribution and transmission system (e.g., Cape Cod versus Boston). Therefore, not only specific-area extreme weather must be considered but also some coincident or non-coincident factors need to be applied when using these forecasts for a given area, sub-station or a particular feeder.

Second, NSTAR has not addressed the potential of demand-side management ("DSM") measures to reduce load in its forecasts. DSM programs, such as the use of efficient equipment in homes, reduce energy consumption overall in the system. Together with energy efficiency and load-shifting applications, DSM programs can reduce overall peak demand.

Therefore, the effect of DSM programs needs to be incorporated in NSTAR's load forecasting process.

Third, NSTAR has not addressed the effect of peak load shaving or load shedding implemented by certain customers (industrial or commercial). During the inevitable times of peak load, there are customers who are willing to reduce their load. By reducing their load, peak demands can be reduced, which will reduce the stress on the distribution system. Therefore, the effect of peak load shaving or load shedding needs to be incorporated in load forecasting.

Fourth, NSTAR has not addressed the effect of T&D system losses and its effect on the peak demand forecasts. T&D system losses are an integral part of a total system load that need to be considered in serving customer load. By using more efficient equipment, such as transformers, large wires, and capacitors, the magnitude of peak load demand required at the system level could be reduced. Therefore, NSTAR's plans regarding the use of more efficient equipment need to be addressed and incorporated in its load forecasting process.

Fifth, NSTAR has not discussed whether it intends to use extreme weather forecasts for planning facilities during normal system conditions or during both normal and emergency conditions. As seen this past summer, customers' demand for electricity increases considerably during extreme weather conditions. If the existing T&D system is examined for its normal operation (without outages) during an extreme weather condition, it would provide information about equipment capability during times of higher peak demands and extreme weather. If the T&D system and the facilities are planned for emergency operation (with

outages) during an extreme weather condition, it would uncover and identify any and all weaknesses in the system and customer outages would be minimized in the most practical manner. Therefore, NSTAR must consider the use of extreme weather condition forecasts with outages or contingencies simulated in the power flow model as the worst case for planning and designing T&D facilities.

Based on the foregoing, the Department finds that, while the steps NSTAR has undertaken may improve its load forecasting ability, there are further steps that NSTAR should take. The Department directs NSTAR to consider including the following in its load forecasting process and to report back by June 1, 2002 on the value and feasibility of these measures:

- 1. The probability level, or some other means such as standard deviation or a bandwidth, by which the normal and the extreme weather forecasts of individual area(s), sub-station(s) and the system as a whole can be determined; and
- 2. The effect of peak load shaving or load shedding applications/incentives to reduce peak load demand forecasts;
- 3. The effect of equipment efficiency programs (DSM programs) to reduce peak load forecasts:
- 4. The effect of T&D system losses, and measures to reduce them, in system-wide peak demand forecasts; and
- 5. The use of extreme weather peak demand forecasts which ultimately would be applied in planning facilities during normal as well as contingency or emergency conditions.

The Department also directs NSTAR to submit annually 10-year peak demand load forecasts for summer and winter. The forecasts should include, but not be limited to, all of the factors discussed above.

C. <u>Communications and Notifications Procedures</u>

1. NSTAR

In its Notice Opening Investigation, the Department requested information regarding the appropriateness of NSTAR's communications and notifications procedures. In particular, the Department sought information regarding procedures during outage and storm recovery, both internal to the company and between the company and the following entities: municipalities, affected neighborhoods, political leaders, and regulators. The Department made specific inquiry into NSTAR's use of accurate and real-time updates.

In response, NSTAR states that the outages of 2001 highlighted a number of implementation issues with respect to the quality and timeliness of historic outage data, the availability of outage and restoration information during outage events, and adherence to necessary business processes during those time periods (Report 1, at 11). NSTAR states that all of these factors affected the Company's ability to process information internally, and as a result, to manage outage events externally (id.). Specifically, NSTAR acknowledges that communications from the people actually working in the field on the outage to the dispatch center, and from the dispatch center to the call center and, ultimately, to external customers and community liaisons, did not have consistency and completeness and needed improvement (Tr. 8, at 20). As one result of these communication failures, NSTAR did not have ability to communicate effectively to communities and customers regarding their outages (id.).

Regarding NSTAR's internal processes and communications on outages, NSTAR is implementing a number of measures designed to improve the flow and reporting of

information during outage and storm recovery both internally and externally (Report 1, at 11). NSTAR states that since 2000, it has invested \$144 million in the implementation of a major information system that is designed to support the Company's business processes and to increase the effectiveness and efficiency of the Company's operations across its service territories (id. at 9). This system includes the following: (1) a customer information system ("CIS"); (2) a work management system; and (3) an outage management system (id. at 9-10). Collectively, this system will be known as "M3i."⁶

NSTAR states that when the M3i system is fully implemented it will significantly automate the trouble reporting system, improve the accuracy of outage reporting statistics, allow for more accurate and timely flow of information, and will provide a facility to accomplish a range of outage related processes (id. at 10). NSTAR claims that the M3i system has the capability to integrate a number of complementary systems, including the CIS, the geographic information system ("GIS") and the supervisory control and data acquisition ("SCADA") system (id. at 10). The first phase of the M3i system will be completed by April 2002 (id. at 11).

Regarding NSTAR's external processes and communication on outages, NSTAR acknowledges that customers and their representatives, including municipal officials, should receive outage information on a timely basis (<u>id.</u> at 13). While NSTAR has had a Storm Restoration Plan ("SRP") in place, NSTAR states that it recently expanded its notification procedures to cover non-SRP situations and to reach the general public (<u>id.</u> at 13-14).

M3i will serve as the basis for NSTAR's improvement plans going forward.

Furthermore, NSTAR recently developed key contact lists as required by the Department-mandated outage reporting system ("ORP") so that the proper community officials, as well as the Department, are notified during an outage or regarding other important issues (Tr. 8, at 32-33).

2. <u>Analysis and Findings</u>

It appears that NSTAR has made many necessary improvements to its communication procedures, particularly infrastructure improvements and implementation of the M3i System. Nonetheless, the Department has some concerns. First, NSTAR has not provided projected dates for implementation and completion of each of the phases of M3i System (and for verification of the validity, continuity and usefulness of the system) including a progress report of GIS system implementation of all distribution circuits and linkage to distribution planning software such as CYMEDIST acquired by NSTAR, across all three companies of NSTAR's service territories. Second, NSTAR has not addressed the following: (1) how the existing ORP would benefit from the future improvements in the notification and communication process upon completion of the first phase of the M3i System; and, (2) how NSTAR will regularly update its key contact lists. Regarding the contact lists, the requirement to update lists of key contacts at both the municipal and the Department level is an important attribute of the ORP. Therefore, the Department directs NSTAR to report the following:

1. Progress reports on (a) implementation and completion of each of the phases of the M3i System and (b) verification of the validity, continuity, and usefulness of the M3i system, and (c) integration with ORP;

2. Progress report on implementation of the GIS system and linkage to CYMEDIST power flow software for modeling and preparing for planning studies; and

3. The method and regularity by which its key contact lists will be updated, consistent with the ORP.

D. <u>Use of Emergency Generators and Other Equipment</u>

1. NSTAR

In its Notice Opening Investigation, the Department requested information regarding the adequacy of NSTAR's procedures regarding the deployment of emergency generators and other equipment to restore critical service or ease prolonged interruptions. NSTAR responds that its procedures are reasonable, appropriate, and consistent with industry practice (Report 1, at 15).

NSTAR states that it has emergency generation equipment available to assist in maintaining or restoring electric service in emergency or life-threatening situations (<u>id.</u> at 14). Specifically, NSTAR maintains four mobile engine generators and two portable pad-mount transformers and also has access to other units that can be brought in should circumstances require (<u>id.</u> at 14-15). When an outage occurs on the electric distribution system, NSTAR claims it evaluates the use of temporary electrical supply options, such as portable pad-mount transformers and mobile generators (<u>id.</u> at 15).

2. <u>Analysis and Findings</u>

It is reasonable for NSTAR to balance the feasibility of restoring critical loads using temporary means with the time it will take to permanently restore power. NSTAR, however, fails to assess the need for the availability of emergency generators and mobile transformers to restore power to customers in remote locations, such as Martha's Vineyard. The outage of

main underwater supply cables to Martha's Vineyard could take considerable time to repair, particularly in storm or extreme weather conditions, causing long and extended period of customer outages. Deployment of higher voltage, mobile sub-station transformers on main line or even at bulk-substation level could restore power to large number of customers. Therefore, the Department directs NSTAR to include the following in its deployment of emergency generator and equipment and to report back by June 1, 2002:

- 1. A list of available emergency generators and mobile transformers at distribution supply voltage level (of all NSTAR service companies) and a description of NSTAR's procedures and readiness to deploy them to restore power outages;
- 2. A list of spare or available transformers (mobile or otherwise) at sub-transmission level and at high voltage transmission or high voltage bulk-substation level, and a description of NSTAR's procedures and readiness to deploy them during an emergency power restoration process; and
- 3. A survey of NSTAR's large institutional customers, including hospitals, schools, and municipal buildings, that assesses whether these customers have adequately sized their own back-up generation.

E. <u>Personnel Staffing and Deployment</u>

1. Personnel Availability

a. <u>NSTAR</u>

In its Notice Opening Investigation, the Department requested information regarding the soundness of personnel availability and work crew call-up and deployment procedures.

NSTAR responds that enhancements to its existing procedures are necessary in certain non-SRP situations that fall between SRP situations and brief, localized outages (Report 1, at 15-16).

NSTAR states that during the storms over the Fourth of July holiday weekend in 2001, the Company experienced an abnormally low response rate to its call-in process (<u>id.</u> at 16).

No advance arrangements had been made to assure that employees would respond to weekend call-ins (id.). Because of the holiday weekend, there were a large number of line personnel who did not respond to the Company's calls to their homes (id.). NSTAR states that they had some gaps in their policies and procedures for staffing needs on weekends (Tr.8, at 21). NSTAR states that the Company has taken several actions: (1) it has instituted scheduling of routine planned work for holiday weekends and recruiting of line workers to work on weekends; (2) it pre-polls employees, contractors and line crews for their availability for the weekend period; and, (3) it will turn to the neighboring utilities for mutual assistance (Report 1, at 16-17).

b. <u>Analysis and Findings</u>

The Department recognizes that line crews normally work on a weekday schedule. In the vast majority of cases, troubleshooters are able to restore service to customers. In those cases requiring a crew, the division on-call supervisor is notified by the dispatch group that a crew is required and the supervisor initiates the call-in. The crews report to the center and are dispatched to the trouble locations. By instituting scheduled routine work for holidays and weekends and pre-arranging the availability of employees and contractors on weekends and holidays, NSTAR would help expedite the restoration of service to customers. Therefore, NSTAR's revised employee and work crew availability and call-up procedure is reasonable overall and should be maintained across all NSTAR service territories.

2. <u>Weather Forecasting</u>

a. <u>NSTAR</u>

In its Notice Opening Investigation, the Department also sought information regarding NSTAR's weather forecasting. NSTAR responds that it relies on multiple resources to monitor and evaluate weather conditions, including subscriptions to a weather forecasting service, monitoring web sites of Intellicast, Accuweather and the National Weather Service, all of which are occasionally supplemented by special weather bulletins in the event of severe weather conditions (Report 1, at 26-28). NSTAR states that these weather reports are received in NSTAR's system control center on a continuous basis (id.).

Based on weather broadcasting information, NSTAR adjusts its staff as needed (<u>id.</u> at 27-28). In the case of a small, localized threat, NSTAR doubles its troubleshooters and extra dispatch staffing for a small localized threat (<u>id.</u> at 28). For a moderate threat, NSTAR keeps line crews on duty after their normal shift or adds extra dispatch staffing (<u>id.</u>). In case of a severe or highly probable threat, NSTAR increases the troubleshooters, holds or schedules all line crews, and supplements dispatch staffing (<u>id.</u>).

b. Analysis and Findings

NSTAR now avails itself of reasonable avenues of weather forecasting and operates in accordance with the practices of the other electric distribution companies (id. at 26-28). The Company, however, must ensure that it maintains a close nexus between forecast reports of extreme weather and adequate staffing of both line crews and the consumer call center commensurate to those reports.

3. <u>Employee Staffing Levels</u>

a. NSTAR

In its Notice Opening Investigation, the Department requested information regarding the adequacy of employee staffing levels for operation and maintenance of the distribution system, including inspection staffing levels. NSTAR states that in the past two years, it has diverted staff to activities that are unrelated to system maintenance, such as performance of generation interconnection studies and congestion mitigation studies (Report 1, at 28-29). NSTAR states that to eliminate backlog of preventive and corrective maintenance activities and to address customer reliability of service issues, it will fill approximately 100 new positions in the electric operations, shared services, customer care, asset management and information systems areas (id. at 29).

b. <u>Analysis and Findings</u>

The adequacy of properly trained staff to maintaining good service and to restoring service in a timely way after an outage is a matter of great importance. While NSTAR is in the process of adding staff to its various divisions as described, it omitted the staffing levels needed in its forecasting, distribution planning, distribution engineering, and field engineering departments. NSTAR states that reassigning staff from system planning to perform generation interconnection studies and congestion mitigation studies was the cause of the backlogs. NSTAR, however, proposes to use that same planning staff to carry the extra burden of linking GIS to the CYMEDIST distribution software for other planning studies. Based on the foregoing, the Department directs NSTAR to do the following:

1. Address the adequacy of staffing levels needed in the forecasting, distribution planning, system planning, distribution engineering and field engineering departments and to identify the work load required; and

2. Provide progress report on hiring activities to remedy identified deficiencies.

3. <u>Training Programs for Employees</u>

a. NSTAR

In its Notice Opening Investigation, the Department requested identification of all training programs for employees engaged in electric service operation and restoration efforts.

NSTAR responds that it dedicates a significant amount of time and resources to the training of its operational personnel in the areas of system maintenance and storm restoration (id. at 30).

NSTAR specifically details its structured program for technical skills in the craft areas of overhead, underground, sub-station, and dispatch and meters (<u>id.</u>). NSTAR further reports that all union and management employees attend annual compliance training as required by each respective craft (<u>id.</u>).

b. Analysis and Findings

While NSTAR's training programs for employees engaged in electric service operation and restoration efforts are acceptable, the Department directs NSTAR to report on its training of new employees that will be hired not only in the maintenance area but in all activities related to customer outages and restoration of electric service.

4. <u>Inspection of Above-Ground and Underground Distribution Plant</u>

a. NSTAR

In its Notice Opening Investigation, the Department requested a cost-benefit assessment of establishing a program of periodic inspection of both above-ground and underground distribution, to be conducted by personnel who are expressly dedicated to inspection.

NSTAR states that it schedules equipment inspections and preventive maintenance activities in per fixed cycle periods (Report 1 at 32). Further, it states that inspections must be performed by personnel who have the knowledge of and experience with the distribution system component under inspection (<u>id.</u>). When not performing such inspections, these personnel perform both corrective and preventive maintenance on the equipment (<u>id.</u> at 33).

NSTAR states that, based on its experience, it is neither cost-effective nor beneficial for it to de-couple maintenance activities from inspection activities and devote a category of personnel exclusively to inspection (id.). Finally, NSTAR stated that combining the inspection and maintenance work processes is an efficient and effective approach (id.).

b. Analysis and Findings

NSTAR has employees whose work includes distribution line and system inspections. These employees have information regarding the condition and performance of the distribution system components and infrastructures that the T&D planning engineers need for their analysis of infrastructure improvement and system upgrade recommendations. Therefore, the Department directs NSTAR to consider having dedicated staff available to

provide this information to the distribution planning and system planning areas and to report back on the value and feasibility of doing so by June 1, 2002.

F. <u>Maintenance and Design</u>

1. <u>Overall Maintenance Practices and Spares Inventory</u>

a. NSTAR

In its Notice Opening Investigation, the Department requested information regarding the adequacy of overall and particular community maintenance practices and of equipment and spares inventory to meet outage restoration demands. NSTAR responds that while it has had preventive and corrective maintenance programs in place, it must make improvements in two key areas: elimination of work backlogs; and, accelerating infrastructure improvements and inspections (Report 1, at 20).

As part of its preventative maintenance program, NSTAR includes tree trimming (<u>id.</u> at 19). NSTAR claims tree trimming keeps vegetation away from overhead lines, which improves circuit reliability (<u>id.</u>). NSTAR states that it is presently implementing its tree trimming on a circuit basis rather than a town basis (Tr. 8 at 39).

Regarding the elimination of work backlogs, NSTAR states that it has re-prioritized work schedules and reallocated system resources (id.). Regarding the acceleration of infrastructure improvements in the City of Boston, NSTAR provided a report on infrastructure improvements that indicates that a total of eleven high-priority system improvement projects in six neighborhoods and 33 projects within fourteen neighborhoods will be completed on an accelerated basis by June of 2002 (id. at 21). A similar effort is

well-advanced in the Town of Brookline and on schedule for a May 15, 2002 completion as per the Department's letter of August 17, 2001. A third effort is also underway for several suburban communities outside Boston (e.g., Arlington, Burlington, Lexington, Medfield, Millis, Newton, Sharon, Stoneham, and Somerville). Finally, NSTAR has also increased its electric system inspections (id. at 20).

b. <u>Analysis and Findings</u>

While NSTAR has provided a report on planned infrastructure improvements, it has not made a similar report for tree trimming, the elimination of work backlog, or inspections. Therefore, the Department directs NSTAR to provide, quarterly commencing June 1, 2002, a schedule detailing when backlogged work will be completed, as well as a schedule of tree trimming activities and inspections. The Department also directs NSTAR to report on the cooperation by and coordination with communities in tree trimming activities.

2. <u>Distribution Design</u>

a. <u>NSTAR</u>

In its Notice Opening Investigation, the Department requested the identification of distribution design flaws that led to repeated outages on particular circuits, especially circuits that serve critical community facilities. NSTAR responds that there are no fundamental technical flaws in the overall design of its distribution system (Report 1, at 23). NSTAR has decided, however, to convert overburdened 4kV underground facilities to 13.8kV open-loop facilities throughout its distribution system (id.).

NSTAR's self-assessment identified approximately 275 circuits feeding 130,000 customers through over-burdened 4kV underground segments as a major source of radial distribution design flaws that created a burdensome process in locating faults and failures causing increased outage duration (id. at 24). Because NSTAR's design criteria at the 4kV level for the underground system did not provide for fuse protection, a failure on 4kV system can cause an outage of the entire circuit (Tr. 8, at 24). NSTAR further states that finding the location of failure was performed by trial and error, which caused customers to see their power come on and go off several times during the repair process (Report 1, at 24). NSTAR states that it has accelerated its planned schedule to convert 4kV radial circuits to 13.8kV open loop system on an accelerated basis in the City of Boston and in the Town of Brookline (id. at 24-25). Because an open-loop system allows customers to be fed from two different directions, a significant improvement increase on the overall reliability of service will be expected in those service territories (id.).

b. <u>Analysis and Findings</u>

The conversion to a 13.8kV open-loop system will increase NSTAR's service reliability. However, the fundamental design criteria of number of exit or getaway circuits to be allowed in a manhole, the planned loading level criteria of the entire distribution system, whether underground or overhead, and the amount of load transferred from one station to the others during emergency are extremely important factors to reduce or prevent future outages. Simulations of the loading of transformers, circuit breakers, switches, fuses and overhead wires and underground cables in a computer model using extreme weather future load

projections will not only allow engineers and management to identify the unexpected problems, but also will allow NSTAR to carry out pre-emptive actions to prevent long and sustained outages at considerably less expense and inconvenience to customers in the future. NSTAR is in the process of implementing a GIS of all distribution circuits in all three companies into CYMEDIST, a computer software model to analyze various planning studies. Therefore, the Department directs NSTAR to do the following to improve its distribution design and planning process:

- 1. Provide complete planning criteria and distribution design guidelines for the distribution planning process;
- 2. Submit an operating study showing power flows and voltages for normal and emergency conditions, including a contingency analysis, at each sub-station or bulk-substation in NSTAR Electric's service territory;
- 3. Provide a list of large institutional customers (including hospitals and municipal buildings) by town, their magnitude, the circuit on which they are fed, as well as NSTAR's plans to provide electricity to them during most critical contingencies; and
- 4. Provide a list of significant T&D improvement projects, identifying their cause, prioritizing future projects, and including a one-line schematic and geographical diagrams, as well as power-flow diagrams for each project.

G. Other Issues

The Attorney General and DOER request that the Department order an Independent Post-Merger Management Audit of NSTAR based on the customer comments at the public hearings and NSTAR's own self-assessments (Joint Comments at 8). The Attorney General and DOER state that during the public hearings, customers and their representatives criticized NSTAR's management and management policies and described numerous outages over the past two years (id. at 4). Further, the Attorney General and DOER argue that NSTAR acknowledged in its own Report that it has improperly managed, operated, and maintained its

distribution system (<u>id.</u> at 2, 3-4). The Company responds that there is no reasonable basis to grant this request because (1) NSTAR's operations have already been audited by three independent consultants, (2) the Attorney General and DOER have not stated any benefit to such an audit, and, (3) the record does not warrant such action especially in light of NSTAR's efforts to avoid a recurrence of last summer's outages (Reply at 24).

At the public hearings, customers and their representatives criticized NSTAR's management and management policies and described numerous outages over the past two years. Some customers and their representatives also stated that it appeared NSTAR was making progress on correcting these problems (Tr. 8, at 37-39). Furthermore, while the independent consultants hired by NSTAR found problems with NSTAR's management and operation of its distribution system, the record also shows that precipitating factors, such as unusually severe summer storms, unprecedented demand for electricity, and exponential load growth in certain areas of the distribution system, influenced the occurrence of outages (Tr. 8, at 23, 25)

The record shows that NSTAR has taken a number of steps to improve its reliability. Further, the Department has issued directives that should also improve reliability. The Department must monitor NSTAR progress in completing its plans and the Department's directives to fully evaluate the necessity of an independent management audit of NSTAR's management. Therefore, the Department defers action on the Attorney General's and DOER's request at this time.

III. <u>CONCLUSION</u>

NSTAR has taken many steps to improve its service quality since prolonged severe weather in the Summer of 2001. The Department, however, directs NSTAR to take further action with regard to the several areas described above. First, with respect to growth forecasting, NSTAR should adjust its forecasting process to include several variables, including the effects of extreme weather, peak load shaving and DSM programs. Second, with respect to staffing, NSTAR should address staff levels needed in the forecasting, distribution planning, system planning, distribution engineering and field engineering departments. Third, with respect to distribution design, NSTAR should address certain fundamental design criteria to reduce or prevent future outages. Fourth, NSTAR should provide further information regarding communication procedures and temporary restoration equipment. To ensure that NSTAR completes its planned improvements to its distribution system and that NSTAR performs directives in accordance with these, NSTAR shall make the following annual reports and quarterly reports for the next two years beginning June 1, 2002:

- 1. <u>Annual Reports Commencing January 1, 2003</u>

 Ten-year peak demand load forecasts; planning criteria and guidelines for the entire distribution system planning process; an operating study report showing power flows and voltages for normal and emergency conditions; listing of critical loads by town; listing of significant reliability improvement and infrastructure improvement projects; prioritization of future projects; and
- Quarterly or Progress Reports Commencing June 1, 2002 and Ending After June 1, 2004
 M3i implementation; GIS systems implementation and results as well as linkage to CYMEDIST; listing of available emergency generators, mobile transformers, and transformers as well as deployment procedures; hiring and training activities of 100 employees in the described divisions; listing of scheduled work regarding tree trimming and the elimination of the work backlog and inspections, including pole inspections.

In addition, on June 1, 2002, NSTAR shall file with the Department a Summer 2002 Readiness Report, assessing (with supporting documentation) its expected ability to respond adequately this coming summer to a repetition, if there should be one, of the severe weather conditions experienced in the June-August 2001 period. To the extent any of the filing requirements directed by the Department raise the concerns regarding system security, the Company should follow normal procedures for protecting confidential information.

By Order of the

Department,

James Connelly, Chairman
W. Robert Keating, Commissioner
Paul B. Vasington, Commissioner
Eugene J. Sullivan, Jr., Commissioner
Deirdre K. Manning, Commissioner